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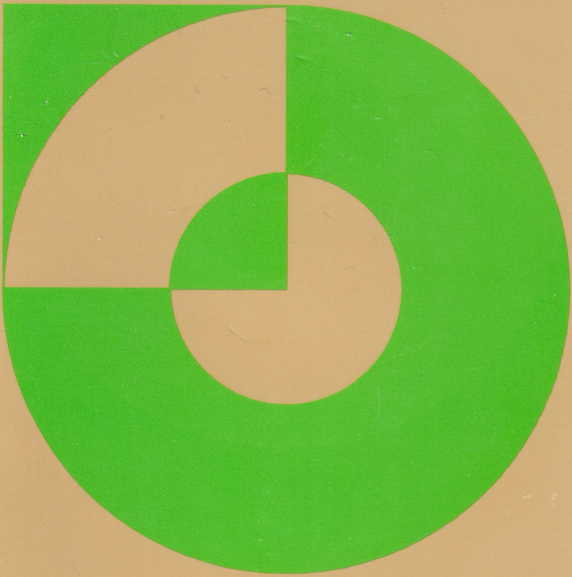
IBM 3390
Direct Access Storage Reference Summary



GX26-4577-2

IBM Storage Subsystem Library

IBM 3390 Direct Access Storage Reference Summary

GX26-4577-2

Third Edition (August 1990)

This edition of *Storage Subsystem Library: IBM 3390 Direct Access Storage Reference Summary* replaces and makes obsolete the previous edition, GX26-4577-1. This reference summary is based on material found in *IBM 3390 Direct Access Storage Introduction*, *Using IBM 3390 in an MVS Environment*, *Using IBM 3390 in a VM Environment*, and *Using IBM 3390 in a VSE Environment*.

This edition applies to all models of IBM 3390 Direct Access Storage. Consult the latest edition of the applicable IBM system bibliography for current information on this product.

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3390 Publications

IBM 3390 Direct Access Storage Introduction	GC26-4573
Using IBM 3390 Direct Access Storage in an MVS Environment	GC26-4574
Using IBM 3390 Direct Access Storage in a VM Environment	GC26-4575
Using IBM 3390 Direct Access Storage in a VSE Environment	GC26-4576
IBM 3390 Direct Access Storage Reference Summary	GX26-4577

3990 Publications

IBM 3990 Storage Control Introduction	GA32-0098
IBM 3990 Storage Control Planning, Installation, and Storage Administration Guide	GA32-0100
IBM 3990 Storage Control Reference	GA32-0099
Cache Device Administration	GC35-0101
IBM 3990 Operations and Recovery Reference	GA32-0133
IBM 3990 Operations Study Guide	GA32-0131
Introduction to Nonsynchronous Direct Access Storage Subsystems	GC26-4519

Shared Publications

Maintaining IBM Storage Subsystem Media	GC26-4495
Storage Subsystem Library: Master Bibliography, Index, and Glossary	GC26-4496

IBM Direct Access Storage Device Comparisons

3390 Mode: Characteristics

The following table compares characteristics of the 3390 models with other IBM DASD. All figures are presented in the order the models are listed in the table heading. Only one number in a column indicates that it applies to all models listed in the particular heading. Capacity figures assume use of standard IBM R0.

Note: ms (milliseconds) equals 10^{-3} seconds, MB equals 10^{6} bytes and GB equals 10^{9} bytes.

	3380 AD4 BD4 AJ4 BJ4	3380 AE4 BE4	3380 AK4 BK4	3390 A14 B14 A18 B18 B1C	3390 A24 B24 A28 B28 B2C
Performance Characteristics					
Single cylinder seek time (ms)	3 2	3	2	1.5	1.5
Average seek time (ms)	15 12	17	16	9.5	12.5
Maximum seek time (ms)	28 21	31	29	18	23
Full track rotation (ms)	16.6	16.6	16.6	14.1	14.1
Average rotational delay (ms)	8.3	8.3	8.3	7.1	7.1
Data transfer rate (MB/sec)	3.0	3.0	3.0	4.2	4.2
Maximum Capacity Specifications					
Bytes per track	47 476	47 476	47 476	56 664	56 664
Bytes per cylinder	712 140	712 140	712 140	849 960	849 960
MB per device	630	1 260	1 890	946	1 892
MB per HDA	1 260	2 520	3 781	1 892	3 784
MB per unit	2 520	5 041	7 562	3 784 7 568 11 352	7 568 15 136 22 704
GB per full string	10.08	20.16	30.25	30.27[1]	60.54[1]
Physical Characteristics					
HDAs per unit	2	2	2	2 4 6	2 4 6
Devices (volumes) per HDA	2	2	2	2	2
Data read/write heads per device	15	15	15	15	15
Servo head per device	1	1	1	1	1
Data cylinders per device	885	1 770	2 655	1 113	2 226
Tracks per cylinder	15	15	15	15	15
Data tracks per device	13 275	26 550	39 825	16 695	33 390
Ratio of devices (volumes) to approximate equivalent capacity	3.0	1.5	1.0	2.0	1.0

Note

[1] A full 3390 string is composed of one An8 and two BnC models where "n" is the model number (for example A18).

3380 Track Compatibility Mode: Capacity

The following table shows maximum capacity figures for a 3390 running in 3380 track compatibility mode. All figures are presented in the order the models are listed in the table heading. Only one number in a column indicates that it applies to all models listed in the particular heading. These figures assume use of IBM standard R0.

Maximum Capacity Specifications: 3380 Track Compatibility Mode	3390 A14 B14 A18 B18 B1C	3390 A24 B24 A28 B28 B2C
Bytes per track	47 476	47 476
Data tracks per device	16 695	33 390
Bytes per cylinder	712 140	712 140
Data cylinders per device	1 113	2 226
MB per device	792	1 585
MB per HDA	1 585	3 170
MB per Unit	3 170 6 340 9 511	6 340 12 681 19 022
GB per full string	25.36[1]	50.72[1]

Note

[1] A full 3390 string is composed of one An8 and two BnC models where "n" is the model number (for example A18).

Determining Track Capacity

3390 Mode

Each 3390 Mode track is divided into 1729 user data cells (with IBM standard R0) or 1749 user data cells (without IBM standard R0 record). A record can occupy from 20 to 1749 of these cells. The number of cells (*Space*) occupied by a record is a function of the Key Length (*KL*) and Data Length (*DL*) as specified in the count area of the record.

Space Calculation

The space, in cells, occupied by a record can be calculated from the following formula:

$$\text{Space} = C + K + D$$

where:

$C = 10.$

K depends on the key length.

If $KL=0$, $K=0$

If KL does not equal 0:

$$K = 9 + \frac{KL + (6 \times KN) + 6}{34}$$

$$\text{where: } KN = \frac{KL + 6}{232}$$

$$D = 9 + \frac{DL + (6 \times DN) + 6}{34}$$

$$\text{where: } DN = \frac{DL + 6}{232}$$

Each equation is rounded up to an integer value.

Track Capacity

A track can hold a given set of records provided that the sum of the *Space* values for all records is less than or equal to the following maximum value:

1729	If an IBM standard R0 is used and the sum of *Space* values does not include R0.
1749	If an IBM standard R0 is **not** used and the sum of *Space* values includes R0.

A standard End of File record has a *Space* value of 20.

If an IBM standard R0 is used and all the other records on a track are of equal *KL* and *DL*, each of which occupies *Space* cells, the maximum number of records (other than R0) which can fit on a track is:

$$\frac{1729}{\mathit{Space}} \text{ rounded down to an integer value.}$$

If an IBM standard R0 is not used and all records on a track are of equal *KL* and *DL*, each of which occupies *Space* Cells, the maximum number of records which can fit on a track is:

$$\frac{1749}{\mathit{Space}} \text{ rounded down to an integer value.}$$

For track capacity examples using the previous equation, see the appropriate operating environment manual:

Using IBM 3390 in an MVS Environment
Using IBM 3390 in a VM Environment
Using IBM 3390 in a VSE Environment.

Space Calculation Tables

3390 Mode

Use the following tables to determine the number of equal-length physical records of a specific size that can fit on a track or cylinder. After selecting a table that corresponds to the key length of the record, find the length range that includes the specific record size in the column at the left. Read across to find:

- The percentage of space utilized with the maximum record size in the range
- The number of equal-length records of the specific size that can fit on a track or cylinder
- The number of bytes of user data on the track or cylinder when the maximum record size in that range is used.

The examples before the tables provide a data movement scenario that illustrates how to use a table to carry out space calculations. For tables and examples that show key lengths greater than 56 bytes, see the appropriate operating environment manual:

Using IBM 3390 in an MVS Environment
Using IBM 3390 in a VM Environment
Using IBM 3390 in a VSE Environment.

Records without Keys

Table 1 show calculated data lengths for records without keys.

Example: A physical sequential data set is to be moved from a 3380 device to a 3390. The data set contains forty thousand 80-byte records, allocated in 27 200 byte half-track blocks; each block holds 340 records. The data set currently occupies 59 tracks (4 cylinders, if allocated in cylinders) on the 3380.

Table 1 shows that the 27 200 half-track block size corresponds to a data length range of between 18 453 to 27 998. Two of these blocks will fit on a 3390 track. The number of tracks or cylinders required for the data set will be the same, as shown below:

```
   340 = number of 80-byte records / 27200 half-track block
 x   2 = number of 27200 blocks    / track
  ----
   680 = number of 80-byte records / track

 40000 = number of records in the data set
 -----
   680 = number of records / track

    59 = number of tracks (rounded up to next integer)
```

If allocated in cylinders, the number required will be:

```
    59 = number of tracks
    --
    15 = number of tracks / cylinder

     4 = number of cylinders (rounded up to next integer)
```

Table 1. Equal-Length Physical Records Without Keys: 3390 Mode

Data Length Range		Percent Space Used	Max. Track Capacity		Max. Cylinder Capacity	
Min.	Max.		Record	Bytes	Record	Bytes
27 999	56 664	100.0	1	56 664	15	849 960
18 453	27 998	98.8	2	55 996	30	839 940
13 683	18 452	97.7	3	55 356	45	830 340
10 797	13 682	96.6	4	54 728	60	820 920
8 907	10 796	95.3	5	53 980	75	809 700
7 549	8 906	94.3	6	53 436	90	801 540
6 519	7 548	93.2	7	52 836	105	792 540
5 727	6 518	92.0	8	52 144	120	782 160
5 065	5 726	90.9	9	51 534	135	773 010
4 567	5 064	89.4	10	50 640	150	759 600
4 137	4 566	88.6	11	50 226	165	753 390
3 769	4 136	87.6	12	49 632	180	744 480
3 441	3 768	86.4	13	48 984	195	734 760
3 175	3 440	85.0	14	48 160	210	722 400
2 943	3 174	84.0	15	47 610	225	714 150
2 711	2 942	83.1	16	47 072	240	706 080
2 547	2 710	81.3	17	46 070	255	691 050
2 377	2 546	80.9	18	45 828	270	687 420
2 213	2 376	79.7	19	45 144	285	677 160
2 083	2 212	78.1	20	44 240	300	663 600
1 947	2 082	77.2	21	43 722	315	655 830
1 851	1 946	75.6	22	42 812	330	642 180
1 749	1 850	75.1	23	42 550	345	638 250
1 647	1 748	74.0	24	41 952	360	629 280
1 551	1 646	72.6	25	41 150	375	617 250
1 483	1 550	71.1	26	40 300	390	604 500
1 387	1 482	70.6	27	40 014	405	600 210
1 319	1 386	68.5	28	38 808	420	582 120
1 251	1 318	67.5	29	38 222	435	573 330
1 183	1 250	66.2	30	37 500	450	562 500
1 155	1 182	64.7	31	36 642	465	549 630
1 087	1 154	65.2	32	36 928	480	553 920
1 019	1 086	63.2	33	35 838	495	537 570
985	1 018	61.1	34	34 612	510	519 180
951	984	60.8	35	34 440	525	516 600
889	950	60.4	36	34 200	540	513 000
855	888	58.0	37	32 856	555	492 840
821	854	57.3	38	32 452	570	486 780
787	820	56.4	39	31 980	585	479 700
753	786	55.5	40	31 440	600	471 600
719	752	54.4	41	30 832	615	462 480
691	718	53.2	42	30 156	630	452 340
657	690	52.4	43	29 670	645	445 050
623	656	50.9	44	28 864	660	432 960
589	622	49.4	45	27 990	675	419 850
555	588	47.7	46	27 048	690	405 720
521	554	46.9	48	26 592	720	398 880
487	520	45.0	49	25 480	735	382 200
459	486	42.9	50	24 300	750	364 500
425	458	42.0	52	23 816	780	357 240
391	424	40.4	54	22 896	810	343 440
357	390	37.9	55	21 450	825	321 750
323	356	35.8	57	20 292	855	304 380
289	322	33.5	59	18 998	885	284 970
255	288	31.0	61	17 568	915	263 520
227	254	28.7	64	16 256	960	243 840
193	226	26.3	66	14 916	990	223 740
159	192	23.4	69	13 248	1035	198 720
125	158	20.1	72	11 376	1080	170 640
91	124	16.4	75	9 300	1125	139 500
57	90	12.4	78	7 020	1170	105 300
23	56	8.1	82	4 592	1230	68 880
1	22	3.3	86	1 892	1290	28 380

Calculations are made using maximum size records in range.

Records with Keys

Table 2 and Table 3 show calculated data lengths for records with keys.

Example: A BSAM data set is to be moved from a 3380 device to a 3390 device. The data set contains fifteen thousand 1024-byte records, each record has a 32-byte key. The data set currently occupies 39 cylinders (or 577 tracks, if allocated in tracks) on the 3380.

Table 3 shows that a 1024-byte record corresponds to a data length range of between 1019 to 1120. Thus, 27 of these records will fit on a track and 405 records on a cylinder. The number of cylinders required for the data set will therefore be as follows:

```
15000 = number of records in the dataset
-----
  405 = number of records / cylinder


   38 = number of cylinders (rounded up to next integer)

          A saving of 1 cylinder of allocated space.
```

If allocated in tracks, the number required will be:

```
15000 = number of records in the dataset
-----
   27 = number of records / track


  556 = number of tracks (rounded up to next integer)

          A saving of 21 tracks of allocated space.
```

Table 2. Equal-Length Physical Records With Key Length of 1 to 22 bytes: 3390 Mode

Data Length Range		Percent Space Used	Max. Track Capacity		Max. Cylinder Capacity	
Min.	Max.		Record	Bytes	Record	Bytes
27 665	56 336	99.4	1	56 336	15	845 040
18 119	27 664	97.6	2	55 328	30	829 920
13 349	18 118	95.9	3	54 354	45	815 310
10 463	13 348	94.2	4	53 392	60	800 880
8 579	10 462	92.3	5	52 310	75	784 650
7 215	8 578	90.8	6	51 468	90	772 020
6 191	7 214	89.1	7	50 498	105	757 470
5 393	6 190	87.4	8	49 520	120	742 800
4 731	5 392	85.6	9	48 528	135	727 920
4 233	4 730	83.5	10	47 300	150	709 500
3 803	4 232	82.2	11	46 552	165	698 280
3 441	3 802	80.5	12	45 624	180	684 360
3 107	3 440	78.9	13	44 720	195	670 800
2 841	3 106	76.7	14	43 484	210	652 260
2 609	2 840	75.2	15	42 600	225	639 000
2 377	2 608	73.6	16	41 728	240	625 920
2 213	2 376	71.3	17	40 392	255	605 880
2 049	2 212	70.3	18	39 816	270	597 240
1 879	2 048	68.7	19	38 912	285	583 680
1 749	1 878	66.3	20	37 560	300	563 400
1 619	1 748	64.8	21	36 708	315	550 620
1 517	1 618	62.8	22	35 596	330	533 940
1 415	1 516	61.5	23	34 868	345	523 020
1 319	1 414	59.9	24	33 936	360	509 040
1 217	1 318	58.1	25	32 950	375	494 250
1 155	1 216	55.8	26	31 616	390	474 240
1 053	1 154	55.0	27	31 158	405	467 370
985	1 052	52.0	28	29 456	420	441 840
923	984	50.4	29	28 536	435	428 040
855	922	48.8	30	27 660	450	414 900
821	854	46.7	31	26 474	465	397 110
753	820	46.3	32	26 240	480	393 600
691	752	43.8	33	24 816	495	372 240
657	690	41.4	34	23 460	510	351 900
623	656	40.5	35	22 960	525	344 400
555	622	39.5	36	22 392	540	335 880
521	554	36.2	37	20 498	555	307 470
487	520	34.9	38	19 760	570	296 400
459	486	33.4	39	18 954	585	284 310
425	458	32.3	40	18 320	600	274 800
391	424	30.7	41	17 384	615	260 760
357	390	28.9	42	16 380	630	245 700
323	356	27.0	43	15 308	645	229 620
289	322	25.0	44	14 168	660	212 520
255	288	22.9	45	12 960	675	194 400
227	254	20.6	46	11 684	690	175 260
193	226	19.1	48	10 848	720	162 720
159	192	16.6	49	9 408	735	141 120
125	158	13.9	50	7 900	750	118 500
91	124	11.4	52	6 448	780	96 720
57	90	8.6	54	4 860	810	72 900
23	56	5.4	55	3 080	825	46 200
1	22	2.2	57	1 254	855	18 810

Calculations are made using maximum size records in range.

Table 3. Equal-Length Physical Records With Key Length of 23 to 56 bytes: 3390 Mode

Data Length Range		Percent Space Used	Max. Track Capacity		Max. Cylinder Capacity	
Min.	Max.		Record	Bytes	Record	Bytes
27 631	56 302	99.4	1	56 302	15	844 530
18 091	27 630	97.5	2	55 260	30	828 900
13 315	18 090	95.8	3	54 270	45	814 050
10 435	13 314	94.0	4	53 256	60	798 840
8 545	10 434	92.1	5	52 170	75	782 550
7 187	8 544	90.5	6	51 264	90	768 960
6 157	7 186	88.8	7	50 302	105	754 530
5 359	6 156	86.9	8	49 248	120	738 720
4 697	5 358	85.1	9	48 222	135	723 330
4 199	4 696	82.9	10	46 960	150	704 400
3 769	4 198	81.5	11	46 178	165	692 670
3 407	3 768	79.8	12	45 216	180	678 240
3 073	3 406	78.1	13	44 278	195	664 170
2 807	3 072	75.9	14	43 008	210	645 120
2 575	2 806	74.3	15	42 090	225	631 350
2 343	2 574	72.7	16	41 184	240	617 760
2 179	2 342	70.3	17	39 814	255	597 210
2 015	2 178	69.2	18	39 204	270	588 060
1 851	2 014	67.5	19	38 266	285	573 990
1 715	1 850	65.3	20	37 000	300	555 000
1 585	1 714	63.5	21	35 994	315	539 910
1 483	1 584	61.5	22	34 848	330	522 720
1 387	1 482	60.2	23	34 086	345	511 290
1 285	1 386	58.7	24	33 264	360	498 960
1 183	1 284	56.6	25	32 100	375	481 500
1 121	1 182	54.2	26	30 732	390	460 980
1 019	1 120	53.4	27	30 240	405	453 600
951	1 018	50.3	28	28 504	420	427 560
889	950	48.6	29	27 550	435	413 250
821	888	47.0	30	26 640	450	399 600
787	820	44.9	31	25 420	465	381 300
719	786	44.4	32	25 152	480	377 280
657	718	41.8	33	23 694	495	355 410
623	656	39.4	34	22 304	510	334 560
589	622	38.4	35	21 770	525	326 550
521	588	37.4	36	21 168	540	317 520
487	520	34.0	37	19 240	555	288 600
459	486	32.6	38	18 468	570	277 020
425	458	31.5	39	17 862	585	267 930
391	424	29.9	40	16 960	600	254 400
357	390	28.2	41	15 990	615	239 850
323	356	26.4	42	14 952	630	224 280
289	322	24.4	43	13 846	645	207 690
255	288	22.4	44	12 672	660	190 080
227	254	20.2	45	11 430	675	171 450
193	226	18.3	46	10 396	690	155 940
159	192	16.3	48	9 216	720	138 240
125	158	13.7	49	7 742	735	116 130
91	124	10.9	50	6 200	750	93 000
57	90	8.3	52	4 680	780	70 200
23	56	5.3	54	3 024	810	45 360
1	22	2.1	55	1 210	825	18 150

Calculations are made using maximum size records in range.

Determining Track Capacity

3380 Track Compatibility Mode

Each 3380 track compatibility mode track is divided into 1499 user data cells (with IBM standard R0) or 1515 user data cells (without an IBM standard R0). A record can occupy from 16 to 1515 of these cells. The number of cells (*Space*) occupied by a record is a function of the Key Length (*KL*) and Data Length (*DL*) as specified in the count area of the record.

Space Calculation

The space, in cells, occupied by a record can be calculated from the following formula:

$$Space = C + K + D$$

where:

$C = 8.$

K depends on the key length.

If $KL = 0, K = 0$

If KL does not equal 0:

$$K = 7 + \frac{KL + 12}{32}$$

$$D = 7 + \frac{DL + 12}{32}$$

Track Capacity

A track can hold a given set of records provided that the sum of the *Space* values for all records is less than or equal to the following maximum value:

1499 If an IBM standard R0 is used and the sum of *Space* values does not include R0.

1515 If an IBM standard R0 is **not** used and the sum of *Space* values includes R0.

A standard End of File record has a *Space* value of 16.

If an IBM standard R0 is used and all the other records on a track are of equal *KL* and *DL*, each of which occupies *Space* cells, the maximum number of records (other than R0) which can fit on a track is:

$\frac{1499}{Space}$ rounded down to an integer value.

If an IBM standard R0 is not used and all records on a track are of equal *KL* and *DL*, each of which occupies *Space* Cells, the maximum number of records which can fit on a track is:

$\frac{1515}{Space}$ rounded down to an integer value.

For track capacity examples using the previous equation, see the appropriate operating environment manual:

Using IBM 3390 in an MVS Environment
Using IBM 3390 in a VM Environment
Using IBM 3390 in a VSE Environment.

Space Calculation Tables

3380 Track Compatibility Mode

Use the following tables to determine the number of equal-length physical records of a specific size that can fit on a track or cylinder. After selecting a table that corresponds to the key length of the record, find the length range that includes the specific record size in the column at the left. Read across to find:

- The percentage of space utilized with the maximum record size in the range
- The number of equal-length records of the specific size that can fit on a track or cylinder
- The number of bytes of user data on the track or cylinder when the maximum record size in that range is used.

The examples before the tables provide a data movement scenario that illustrates how to use a table to carry out space calculations. For tables and examples that show key lengths greater than 52 bytes, see the appropriate operating environment manual:

Using IBM 3390 in an MVS Environment
Using IBM 3390 in a VM Environment
Using IBM 3390 in a VSE Environment.

Records without Keys

Table 4 shows calculated data lengths for records without keys.

Example: A physical sequential data set is to be moved from a 3380 device to a 3390 running in 3380 track compatibility mode. The data set contains forty thousand 80-byte records, allocated in 23 200 byte half-track blocks, each block holds 290 records. The data set currently occupies 69 tracks (5 cylinders, if allocated in cylinders) on the 3380.

Table 4 shows that the 23 200 byte half-track block size corresponds to a data length range of between 15 477 to 23 476, and that two of these blocks will fit on a track when a 3390 is running in 3380 track compatibility mode. The number of tracks or cylinders required for the data set will be as shown below:

```
  290 = number of 80-byte records / 23200 half-track block
x   2 = number of 23200 blocks    / track
 ----
  580 = number of 80-byte records / track


40000 = number of records in the data set
-----
  580 = number of records / track


   69 = number of tracks (rounded up to next integer)
```

If allocated in cylinders, the number required will be:

```
   69 = number of tracks
   --
   15 = number of tracks / cylinder


    5 = number of cylinders (rounded up to next integer)
```

Table 4. Equal-Length Physical Records Without Keys: 3380 Track Compatibility Mode

Data Length Range		Percent Space Used	Max. Track Capacity		Max. Cylinder Capacity	
Min.	Max.		Record	Bytes	Record	Bytes
23 477	47 476	100.0	1	47 476	15	712 140
15 477	23 476	98.9	2	46 952	30	704 280
11 477	15 476	97.7	3	46 428	45	696 420
9 077	11 476	96.6	4	45 904	60	688 560
7 477	9 076	95.5	5	45 380	75	680 700
6 357	7 476	94.4	6	44 856	90	672 840
5 493	6 356	93.7	7	44 492	105	667 380
4 821	5 492	92.5	8	43 936	120	659 040
4 277	4 820	91.3	9	43 380	135	650 700
3 861	4 276	90.0	10	42 760	150	641 400
3 477	3 860	89.4	11	42 460	165	636 900
3 189	3 476	87.8	12	41 712	180	625 680
2 933	3 188	87.2	13	41 444	195	621 660
2 677	2 932	86.4	14	41 048	210	615 720
2 485	2 676	84.5	15	40 140	225	602 100
2 325	2 484	83.7	16	39 744	240	596 160
2 165	2 324	83.2	17	39 508	255	592 620
2 005	2 164	82.0	18	38 952	270	584 280
1 877	2 004	80.2	19	38 076	285	571 140
1 781	1 876	79.0	20	37 520	300	562 800
1 685	1 780	78.7	21	37 380	315	560 700
1 589	1 684	78.0	22	37 048	330	555 720
1 493	1 588	76.9	23	36 524	345	547 860
1 397	1 492	75.4	24	35 808	360	537 120
1 333	1 396	73.5	25	34 900	375	523 500
1 269	1 332	72.9	26	34 632	390	519 480
1 205	1 268	72.1	27	34 236	405	513 540
1 141	1 204	71.0	28	33 712	420	505 680
1 077	1 140	69.6	29	33 060	435	495 900
1 045	1 076	67.9	30	32 280	450	484 200
981	1 044	68.1	31	32 364	465	485 460
949	980	66.0	32	31 360	480	470 400
917	948	65.8	33	31 284	495	469 260
853	916	65.6	34	31 144	510	467 160
821	852	62.8	35	29 820	525	447 300
789	820	62.1	36	29 520	540	442 800
757	788	61.4	37	29 156	555	437 340
725	756	60.5	38	28 728	570	430 920
693	724	59.4	39	28 236	585	423 540
661	692	58.3	40	27 680	600	415 200
629	660	57.0	41	27 060	615	405 900
597	628	55.5	42	26 376	630	395 640
565	596	55.2	44	26 224	660	393 360
533	564	53.4	45	25 380	675	380 700
501	532	51.5	46	24 472	690	367 080
469	500	50.5	48	24 000	720	360 000
437	468	48.3	49	22 932	735	343 980
405	436	46.8	51	22 236	765	333 540
373	404	45.1	53	21 412	795	321 180
341	372	43.1	55	20 460	825	306 900
309	340	40.8	57	19 380	855	290 700
277	308	38.2	59	18 172	885	272 580
245	276	36.0	62	17 112	930	256 680
213	244	33.4	65	15 860	975	237 900
181	212	30.3	68	14 416	1 020	216 240
149	180	26.9	71	12 780	1 065	191 700
117	148	23.0	74	10 952	1 110	164 280
85	116	19.0	78	9 048	1 170	135 720
53	84	14.6	83	6 972	1 245	104 580
21	52	9.6	88	4 576	1 320	68 640
1	20	3.9	93	1 860	1 395	27 900

Calculations are made using maximum size records in range.

Records with Keys

Table 5 and Table 6 show calculated data lengths for records with keys.

Example: A BSAM data set is to be moved from a 3380 device to a 3390 running in 3380 track compatibility mode. The data set contains fifteen thousand 1024-byte records, each record has a 32-byte key. The data set currently occupies 39 cylinders (or 577 tracks, if allocated in tracks) on the 3380.

Table 6 shows that a 1024-byte record corresponds to a data length range of between 981 to 1044, and that 26 of these records will fit on a track, 390 records per cylinder, when a 3390 is running in 3380 track compatibility mode. The number of cylinders required for the data set will be as follows:

```
 15000 = number of keyed records in the data set
 -----
   390 = number of records / cylinder


    39 = number of cylinders (rounded up to next integer)

If allocated in tracks, the number required will be:


 15000 = number of keyed records in the data set
 -----
    26 = number of records / track


   577 = number of tracks (rounded up to next integer)
```

The two examples showing the movement of the BSAM keyed data set in 3390 mode and in 3380 track compatibility mode, demonstrate the advantage of running the 3390 device in 3390 mode over the 3380 track compatibility mode. You can achieve space savings through the improved device geometry.

Table 5. Equal-Length Physical Records With Key Length of 1 to 20 bytes: 3380 Track Compatibility Mode

Data Length Range		Percent Space Used	Max. Track Capacity		Max. Cylinder Capacity	
Min.	Max.		Record	Bytes	Record	Bytes
23 221	47 220	99.5	1	47 220	15	708 300
15 221	23 220	97.8	2	46 440	30	696 600
11 221	15 220	96.2	3	45 660	45	684 900
8 821	11 220	94.5	4	44 880	60	673 200
7 221	8 820	92.9	5	44 100	75	661 500
6 101	7 220	91.3	6	43 320	90	649 800
5 237	6 100	89.9	7	42 700	105	640 500
4 565	5 236	88.2	8	41 888	120	628 320
4 021	4 564	86.5	9	41 076	135	616 140
3 605	4 020	84.7	10	40 200	150	603 000
3 221	3 604	83.5	11	39 644	165	594 660
2 933	3 220	81.4	12	38 640	180	579 600
2 677	2 932	80.3	13	38 116	195	571 740
2 421	2 676	78.9	14	37 464	210	561 960
2 229	2 420	76.5	15	36 300	225	544 500
2 069	2 228	75.1	16	35 648	240	534 720
1 909	2 068	74.1	17	35 156	255	527 340
1 749	1 908	72.3	18	34 344	270	515 160
1 621	1 748	70.0	19	33 212	285	498 180
1 525	1 620	68.3	20	32 400	300	486 000
1 429	1 524	67.4	21	32 004	315	480 060
1 333	1 428	66.2	22	31 416	330	471 240
1 237	1 332	64.5	23	30 636	345	459 540
1 141	1 236	62.5	24	29 664	360	444 960
1 077	1 140	60.0	25	28 500	375	427 500
1 013	1 076	58.9	26	27 976	390	419 640
949	1 012	57.6	27	27 324	405	409 860
885	948	55.6	28	26 544	420	398 160
821	884	54.0	29	25 636	435	384 540
789	820	51.8	30	24 600	450	369 000
725	788	51.5	31	24 428	465	366 420
693	724	48.8	32	23 168	480	347 520
661	692	48.1	33	22 836	495	342 540
597	660	47.3	34	22 440	510	336 600
565	596	43.9	35	20 860	525	312 900
533	564	42.8	36	20 304	540	304 560
501	532	41.5	37	19 684	555	295 260
469	500	40.0	38	19 000	570	285 000
437	468	38.4	39	18 252	585	273 780
405	436	36.7	40	17 440	600	261 600
373	404	34.9	41	16 564	615	248 460
341	372	32.9	42	15 624	630	234 360
309	340	31.5	44	14 960	660	224 400
277	308	29.2	45	13 860	675	207 900
245	276	26.7	46	12 696	690	190 440
213	244	24.7	48	11 712	720	175 680
181	212	21.9	49	10 388	735	155 820
149	180	19.3	51	9 180	765	137 700
117	148	16.5	53	7 844	795	117 660
85	116	13.4	55	6 380	825	95 700
53	84	10.1	57	4 788	855	71 820
21	52	6.5	59	3 068	885	46 020
1	20	2.6	62	1 240	930	18 600

Calculations are made using maximum size records in range.

Table 6. Equal-Length Physical Records With Key Length of 21 to 52 bytes: 3380 Track Compatibility Mode

Data Length Range		Percent Space Used	Max. Track Capacity		Max. Cylinder Capacity	
Min.	Max.		Record	Bytes	Record	Bytes
23 189	47 188	99.4	1	47 188	15	707 820
15 189	23 188	97.7	2	46 376	30	695 640
11 189	15 188	96.0	3	45 564	45	683 460
8 789	11 188	94.3	4	44 752	60	671 280
7 189	8 788	92.6	5	43 940	75	659 100
6 069	7 188	90.8	6	43 128	90	646 920
5 205	6 068	89.5	7	42 476	105	637 140
4 533	5 204	87.7	8	41 632	120	624 480
3 989	4 532	85.9	9	40 788	135	611 820
3 573	3 988	84.0	10	39 880	150	598 200
3 189	3 572	82.8	11	39 292	165	589 380
2 901	3 188	80.6	12	38 256	180	573 840
2 645	2 900	79.4	13	37 700	195	565 500
2 389	2 644	78.0	14	37 016	210	555 240
2 197	2 388	75.4	15	35 820	225	537 300
2 037	2 196	74.0	16	35 136	240	527 040
1 877	2 036	72.9	17	34 612	255	519 180
1 717	1 876	71.1	18	33 768	270	506 520
1 589	1 716	68.7	19	32 604	285	489 060
1 493	1 588	66.9	20	31 760	300	476 400
1 397	1 492	66.0	21	31 332	315	469 980
1 301	1 396	64.7	22	30 712	330	460 680
1 205	1 300	63.0	23	29 900	345	448 500
1 109	1 204	60.9	24	28 896	360	433 440
1 045	1 108	58.4	25	27 700	375	415 500
981	1 044	57.2	26	27 144	390	407 160
917	980	55.7	27	26 460	405	396 900
853	916	54.0	28	25 648	420	384 720
789	852	52.0	29	24 708	435	370 620
757	788	49.8	30	23 640	450	354 600
693	756	49.4	31	23 436	465	351 540
661	692	46.6	32	22 144	480	332 160
629	660	45.9	33	21 780	495	326 700
565	628	45.0	34	21 352	510	320 280
533	564	41.6	35	19 740	525	296 100
501	532	40.3	36	19 152	540	287 280
469	500	39.0	37	18 500	555	277 500
437	468	37.5	38	17 784	570	266 760
405	436	35.8	39	17 004	585	255 060
373	404	34.0	40	16 160	600	242 400
341	372	32.1	41	15 252	615	228 780
309	340	30.1	42	14 280	630	214 200
277	308	28.5	44	13 552	660	203 280
245	276	26.2	45	12 420	675	186 300
213	244	23.6	46	11 224	690	168 360
181	212	21.4	48	10 176	720	152 640
149	180	18.6	49	8 820	735	132 300
117	148	15.9	51	7 548	765	113 220
85	116	13.0	53	6 148	795	92 220
53	84	9.7	55	4 620	825	69 300
21	52	6.2	57	2 964	855	44 460
1	20	2.5	59	1 180	885	17 700

Calculations are made using maximum size records in range.

Rotational Position Sensing (RPS)

Rotational position sensing (RPS) is a standard feature that reduces the time required for a search. This feature lets a search command be started just before the required record comes under the read/write head.

Rotational position sensing is accomplished by dividing each track in each cylinder into equally-spaced sectors. Each record on a track has a sector location. A sector location number can be sent to the 3990 as a parameter of a Set Sector or Locate Record command. The 3990 then disconnects from the channel until the specified sector is just under the head, thus reducing channel busy time.

The sector location of a record can be obtained by a Read Sector command chained from a read, write, or search CCW. Alternatively, the sector location of a record can be determined from the length of all records ahead of it on the track. S(n), the sector location of record n ($n > 0$) can be calculated with the following formulas. (If $n=0$, $S(n) = 0$.)

The following formulas include some tolerance. A sector location specified as a parameter by a Set Sector or Locate Record command will cause connection ahead of the target record. However, the target record may not be in the calculated sector. A Set Sector command must be followed by a Search command to establish orientation. The Locate Record command sets the sector and establishes orientation.

3390 Mode

The following RPS formula is for a 3390 device operating in 3390 mode.

$$S_n = \frac{1}{8} \times \left[49 + \sum_{i=1}^{n-1} (C + K_i + D_i) \right]$$

Where:

$C = 10$

K_i depends on the key length KL_i,

If $KL_i = 0$, $K_i = 0$

If KL_i does not equal 0:

$$K_i = 9 + \left[\frac{KL_i + (6 \times KN_i) + 6}{34} \right]$$

$$\text{Where } KN_i = \frac{KL_i + 6}{232}$$

$$D_i = 9 + \left[\frac{DL_i + (6 \times DN_i) + 6}{34} \right]$$

$$\text{Where } DN_i = \frac{DL_i + 6}{232}$$

Each equation is rounded up to an integer value.

3380 Track Compatibility Mode

The following RPS formula is for a 3390 device operating in 3380 track compatibility mode.

$$S_n = \frac{1}{7} \times \left[39 + \sum_{i=1}^{n-1} (C + K_i + D_i) \right]$$

Where:

$C = 8$

K_i depends on the key length KL_i,

If $KL_i = 0$, $K_i = 0$

If KL_i does not equal 0:

$$K_i = 7 + \frac{KL_i + 12}{32}$$

$$D_i = 7 + \frac{DL_i + 12}{32}$$

Each equation is rounded up to an integer value.

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